Ontario

Ministry
of the
Environment

Water Resources
Report 15

Hon. Keith C. Norton, Q. C., *Minister*
Gérard J. M. Raymond, *Deputy Minister*

Water Resources of the Holland and Black River Basins

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WATER RESOURCES REPORT 15

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REPORT 15

Water Resources of the Holland and Black River Basins – Summary

By
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MINISTRY OF THE ENVIRONMENT
Water Resources Branch

Toronto

Ontario

1982

INTRODUCTION

Interest in the further development of water resources for various uses in the Holland and Black river basins has prompted the preparation of this comprehensive inventory study of the quality and availability of surface and ground waters in the area. The expected increases in urban and rural residential populations, and the expansion of agriculture and industry will place significant demands on the water resources in the area. Consequently, this report is intended to provide the basic hydrologic data on which rational planning for such development can proceed in the interest of protecting water resources for beneficial and continued uses.

The inventory study in the Holland and Black river basins began in 1976 and proceeded for three years, with major field work undertaken in 1977 and 1978. Field investigations were directed especially to determining surface and ground-water quality throughout the area.

The report deals with the occurrence, distribution, quantity, quality and use of surface and ground waters. The report addresses general hydrologic conditions in the study area and does not attempt to address in detail specific situations or local issues. Topics in the report are presented as maps, graphs and tables, with accompanying explanatory notes, on a set of seven sheets:

Sheet 1: Climate and Physical Setting
Sheet 2: Locations of Selected Water Wells and Logs of Test Holes
Sheet 3: Availability of Ground Water
Sheet 4: Quality of Ground Water
Sheet 5: Surface-Water Hydrology
Sheet 6: Quality of Surface Waters, 1977
Sheet 7: Water Resources Management

ACKNOWLEDGEMENTS

The study was carried out under the general supervision of Mr. U. Sibul and Mr. R. C. Hore of the Hydrology and Monitoring Section whose comments and editorial suggestions are gratefully acknowledged. Thanks are also extended to staff of the Central Region of the Ministry of the Environment for assistance during the course of the study.

SUMMARY

The study area covers about 404 square miles (1046 square kilometres) and is bounded on the north by Lake Simcoe and on the south by the Oak Ridges Moraine. The tributary basins of the study area are:

- Holland River basin (230 square miles or 596 square kilometres)
- Black River basin (129 square miles or 334 square kilometres)
- Maskinonge River basin (21 square miles or 54 square kilometres)
- Small sub-basins draining directly to Lake Simcoe (24 square miles or 62 square kilometres)

Surficial overburden materials in the basin consist mainly of lacustrine, glacial-outwash, fluvial and glacial (till) deposits of Wisconsinan age. Overburden deposits vary from 100 to 700 feet (30 to 213 metres) in thickness. Bedrock in the basin consists of limestone and shale of Ordovician age. Bedrock surface elevations range from about 360 to 700 feet (110 to 213 metres) above mean sea level.

The Holland and Black river basins (alternatively termed as "the basin") are located in the Simcoe and Kawartha Lakes climatic

region. The Oak Ridges meteorological station is considered representative of local climatic conditions in the study area (Sheet 1). The seven-year (1970-1976) average annual streamflow of nine inches (23 centimetres) accounts for about 29 percent of the annual precipitation of 31 inches (79 centimetres) in both the Holland and Black river basins. The remaining 71 percent is attributed to losses primarly through evapotranspiration (22 inches or 56 centimetres). Average annual base flow, estimated from daily streamflows exceeded 60 percent of the time, is about three inches (8 centimetres), or approximately 10 percent of the average annual precipitation.

Hydrogeologic interpretations have been based on data obtained from water well records on file with the Ontario Ministry of the Environment, on documented studies of municipal ground-water availability, and on results of drilling of five test holes by the Ministry in 1977. Most wells in the basin are drilled or bored in overburden and usually satisfy domestic water supply requirements (Sheet 2). Large-capacity wells satisfy municipal needs of a number of basin communities. Bedrock is usually not a good aquifer anywhere in the basin.

Seven overburden aquifer complexes have been mapped in the basin (Sheet 3):

1. the Oak Ridges Aquifer Complex
2. the Kame-Outwash Complex
3. the Algonquin Aquifer Complex
4. The Schomberg Aquifer Complex
5. The Holt Aquifer Complex
6. The Alliston Aquifer Complex
7. The Mount Albert Aquifer Complex

Each complex usually consists of discrete aquifers that are related with respect to time and place of deposition of the sands and/or gravels that form the individual aquifers. The aquifers represent the most permeable materials and are separated by less permeable, fine-grained deposits.

Aquifers in the Oak Ridges Aquifer Complex and the Kame-Outwash Complex in the southern part of the basin, and aquifers in the Algonquin Aquifer Complex in the northeastern section, are the major water-bearing formations at elevations above 700 feet (213 metres). Estimated yields from wells in these complexes adequately support domestic water requirements. Higher yields are common from the Oak Ridges Aquifer Complex along the southern boundary of the basin where a number of wells have estimated yields of up to 300 gallons per minute (23 litres per second).

The Schomberg Aquifer Complex in the west and the Holt Aquifer Complex in the east consist of formations of buried sands and gravels at elevations generally between 680 and 810 feet (207 to 247 metres). Individual well yields in these complexes are variable and range up to about 500 gallons per minute (38 litres per second).

The Alliston and Mount Albert aquifer complexes contain major water-bearing formations at elevations between approximately 360 and 730 feet (110 to 223 metres). Estimated yields of wells in the Alliston Aquifer Complex are generally high. Yields of up to 1200 gallons per minute (91 litres per second) are characteristic of municipal wells in this complex serving the towns of Aurora and Newmarket. Yields of wells in the Mount Albert Aquifer Complex are more moderate and range up to about 600 gallons per minute (45 litres per second).

Horizontal ground-water movement in the basin is generally in a northerly direction towards Lake Simcoe, with deflections locally towards the main streams. Vertical movement of ground water throughout most of the basin is downward. In the Holland Marsh and in the low flats of the Black River, ground-water movement is upward as evidenced by numerous flowing wells in these areas.

Ground-water levels in the basin indicate normal patterns of seasonal change; lows in summer and fall and peaks in the spring. Water levels in wells generally fluctuate between 5 to 15 feet (1.5 to 4.6 metres) annually.

Most ground water is of calcium-bicarbonate type and is generally very hard and highly mineralized (Sheet 4) . Total dissolved solids and iron contents often exceed drinking water objectives. Chloride and sulphate concentrations in ground water are generally lower than the objectives.

Some nitrate levels also exceed the 10 mg/L drinking water objective and levels up to 50 mg/L are found in shallow wells in the north-central section of the basin, especially in the Black River basin north and east of Newmarket. Bacterial quality of ground water in some shallow wells is poor. Ground water is generally low in trace metals and free from polychlorinated biphenyls (PCB) and pesticides.

In 1977, there were three streamflow gauging stations in the area with just over 10 years of continuous streamflow data - on the Black River at Sutton (02EC012), on the East Branch, Holland River at Holland Landing (02EC009), and on the Holland River near Schomberg (02EC010) (Sheet 5). The relatively short duration of the data indicates only small variations in annual streamflows.

Mean annual discharges (1971-1976) in the Black River at Sutton and in the East Branch, Holland River at Holland Landing are 82.8 cfs and 43.9 cfs (2.3 and 1.2 cubic metres per second - cms), respectively. These are equivalent to depths of 8.7 inches and 8.9 inches (22.1 and 22.6 centimetres) of water, respectively, spread over areas upstream of the respective gauging stations. The combined mean annual discharge (1971-1976) from sewage treatment plants (STP) at Aurora and Newmarket is estimated to be 6.9 cfs (0.2 cms), or about 15 percent of the mean annual discharge in the East Branch, Holland River at Holland Landing.

Low flows from the study area into Lake Simcoe, as estimated from daily discharges exceeded 90 percent of the time, are about 33 cfs or 0.08 cfs per square mile (0.93 cms or .001 cms per square kilometre). Individual contributions are 6 cfs (0.17 cms) from the Holland, 15 cfs (0.42 cms) from the Black and 2 cfs (0.06 cms) from the Maskinonge and other small basins. Annual maximum daily

discharges, with an average recurrence interval of 2.33 years, range between 7.8 and 10.1 cfs per square mile (0.09 and 0.11 cms per square kilometre) ; with an average recurrence interval of 50 years, the range is between 23.3 and 35.4 cfs per square mile (0.25 and 0.39 cms per square kilometre).

Annual minimum daily discharges measured at gauging stations on the Holland, East Branch, Holland and Black rivers are 0.017, 0.052 and 0.033 cfs per square mile (0.0002, 0.0006 and 0.0004 cms per square kilometre), respectively.

The surface-water quality in the Holland and Black river basins was determined from data gathered at the 18 Provincial Water Quality Network stations. The long-term data were supplemented with data collected during a synoptic water quality survey (June and July 1977) covering 70 locations in the study area (Sheet 6).

The general surface-water quality shows large fluctuations from year to year, but annual trends for the individual periods of record are not readily apparent. This general water quality is reflected by a combination of six water quality parameters (total coliforms, total phosphorus, nitrate, BOD_5, total solids, turbidity). The Holland and East Branch, Holland rivers are relatively poorer in water quality than the Black River; however, the headwaters in the southern parts of the Holland basin are of relatively better quality than downstream waters, and are of comparable quality to waters throughout the Black River basin.

Water quality parameters are generally within their provincial objectives, except for iron, total dissolved solids, colour, and several bacterial, trace metal and organic parameters which exceed the objectives at some locations.

The bacterial quality of waters is of significant concern in the vicinity of urban areas, notably around Aurora, Newmarket and Schomberg, where total coliforms exceed their respective objectives. High bacterial levels attributed to animal sources are also evident at many locations throughout the study area.

Analyses for eight metals (zinc, chromium, copper, lead, nickel, cadmium, arsenic and mercury) in unfiltered samples indicate that zinc and chromium are the only two metals that consistently exceed the objectives at the stations downstream of Aurora.

Analyses for 16 organochlorine insecticides, 7 triazine herbicides and 3 industrial organochlorines in water indicate their absence in the Black and Maskinonge river basins. DDT, metabolites of DDT, and dieldrin were detected in some water samples from the Holland River basin; in some cases these concentrations exceeded the objectives. The occurrence of organochlorine insecticides are attributed to their past uses in the basin and their long-term persistence in soils and river sediments.

Endosulfan was detected at all sampled locations in the East Branch, Holland River basin and in all cases the total concentrations exceeded the provincial objective. While ethion comprised 80 percent of the organophosphorus insecticide residues, a total of nine residue types were present in the organic soils of the Holland Marsh.

Excluding irrigation, the estimated total water use in 1977 in the basin was 8 million gallons per day (36.4 million litres per day), with 6.8 million gallons per day (30.9 million litres per day) withdrawn from ground-water sources (Sheet 7) . Irrigation is known to be a significant withdrawal use during the market gardening season; over 10 million gallons per day (45.5 million litres per day) were authorized for withdrawal for market garden, golf course and turf-sod irrigation. The most concentrated area of irrigation is the Holland Marsh.

Sixty percent of the 1977 basin population of 80,000 persons was served by public water supply systems, which in 1977 delivered 4.6 million gallons of water per day (20.9 million litres per day). An estimated 1.2 million gallons per day (5.5 million litres per day) was withdrawn through private systems to supply the remaining 40 percent of the basin population. Approximately 2.2 million gallons per day (10 million litres per day) were withdrawn for industrial and commercial purposes.

Impoundments associated with recreation uses in the headwater stream areas are prevalent on the Oak Ridges Moraine. These impoundments have been linked to a number of downstream surface-water interference cases.

The availability of ground water for future development, the poor quality of surface and ground waters locally, and the potential effects of the elimination of the STP discharges into the East Branch, Holland River at Aurora and Newmarket are prominent water management issues in the Holland and Black river basins.

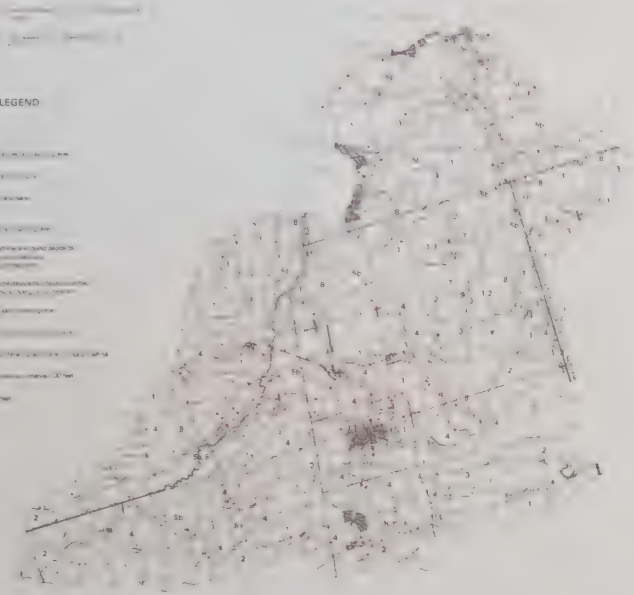
While variable in quality, ground water in the Holland and Black river basins adequately supports water supplies for both private domestic and large municipal and industrial water systems. Most municipalities in the basin rely on ground water for commmunity systems and future planning indicates continued interest in further development of ground water. The aquifer complexes in the basin are capable of moderate to high water yields, and the area in the vicinity of the towns of Aurora and Newmarket is heavily committed to high-capacity wells, most of which draw water from deep aquifers. These two communities make up the high-growth area in the basin where the future development of ground water for municipal supplies will be important.

A significant water management goal for surface waters of the Holland and Black river basins is maintaining and enhancing water quality in general. Improvements in water quality in the future are necessary to ensure the availability of surface water for a wide range of possible future uses. Methods of improving surface-water quality include discouraging the construction of on-stream ponds, especially in headwater areas, and improving controls on agricultural runoff. As well, the elimination of the Aurora and Newmarket STP discharges will improve surface-water quality in the downstream reach of the East Branch, Holland River. At the same time, it is estimated that elimination of the STP discharges will result in about a 15 percent reduction in the mean annual discharge

in the East Branch, Holland River at the Holland Landing streamflow gauge, and monthly flows may be reduced by up to 44 percent during the summer. While the exact effects of this reduction are not known, it is anticipated that if any problems arise they will likely relate mainly to local, in-place aesthetic and recreational interests.

GENERAL SURFICIAL GEOLOGY AND OVERBURDEN THICKNESS

Scale 1 200 000



LEGEND

CENOZOIC

QUATERNARY

RECENT

9 Alluvium

8 Swamp deposits

7 Aeolian deposits

PLEISTOCENE

6 Beach deposits

5 Coarse glaciofluvial sand and gravel deposits

4 Fine glaciolacustrine deposits

3 Fluvial deposits

2 Outwash deposits

1 Bedrock outcrop

100 Overburden thickness, 30 feet

o 282 Overburden thickness, feet

PHYSICAL SETTING AND GEOLOGY

The study area covers about 404 square miles and is bounded in the north by Lake Simcoe and in the south by the Oak Ridges Moraine. The main tributary basins are the Holland River basin (210 square miles) and the Black River basin (128 square miles), both flow into Lake Simcoe.

A distinctive topographic feature in the area is the Oak Ridges Moraine, which forms the heights of land at the southern boundary. Elevation of the Moraine is [illegible] 1200 feet above mean sea level, or about 500 feet above the [illegible] of Lake Simcoe (elevation 718 feet). The Moraine contains [illegible] or kettles. [illegible] parts of the basin. The best known [illegible] area of the Holland River and a [illegible] for market gardening.

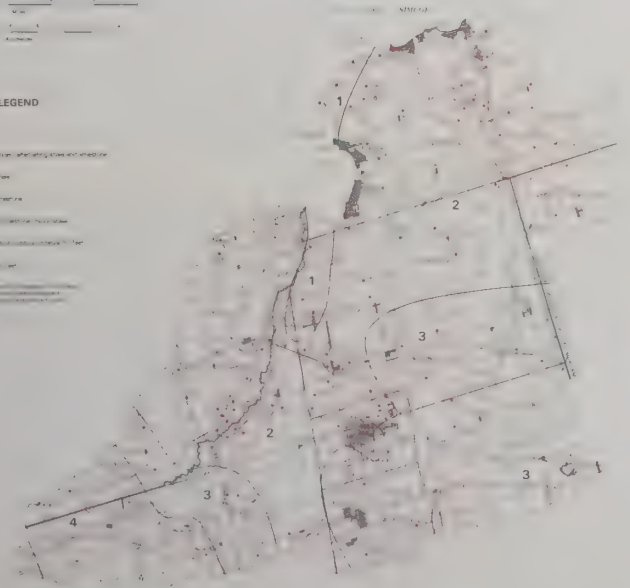
Surficial materials consist of deposits related to the late Wisconsinan age. Lacustrine deposits are generally abundant on the surface, varying from fine-grained deposits of clay, silt and silty sand to coarse-grained sand and beach and bar gravels. Glacio-outwash and fluvial deposits are dominant along the southern and eastern perimeter of the study area, while large areas of till occur along the north-south axis in the central part.

Overburden thickness increases from less than 100 [illegible] corner of the basin to more than 700 feet in the area south of Happy Valley. Overburden deposits along the southern boundary in the Oak Ridges Moraine area are commonly more than 400 feet thick.

Bedrock in the basin consists of limestones and shales of Ordovician age. The bedrock topography displays a prominent depression on which generally follows the trend of the Holland River valley. Bedrock surface elevations in the depression range between 300 and 400 feet. A prominent bedrock high south of Aurora at the southern basin boundary has a local relief of up to 200 feet above the adjoining valley.

BEDROCK GEOLOGY AND TOPOGRAPHY

Scale 1 200 000



LEGEND

PALEOZOIC

ORDOVICIAN

4 Georgian Bay Formation: alternating shale and limestone

3 Whitby Formation: shale

2 Lindsay Formation: limestone

1 Kenilworth Formation: argillaceous limestone

Bedrock surface elevation, 100 feet

Lower bedrock surface elevation, 50 feet

AVERAGE ANNUAL WATER BUDGET

Average annual streamflows (R) account for about 26% of the average annual precipitation (P) in both the Holland and Black river basins, about 71% of the precipitation is lost through evapotranspiration and other water losses (ET). Streamflow measurements were obtained from gauging stations on the East Branch, Holland River at Holland Landing (gauging station 02EC0019) and on the Black River at Sutton (gauging station 02EC012) for which a complete set of current (1970-1976) streamflow records were available. Precipitation measurements were obtained from the meteorological station at Oak Ridges for the same 7 year period. The following 7-year average (1970-1976) water budget equation applies for both the Holland and [illegible]:

$$P = R + ET$$

$$31 = 8 + 22$$

The 7 year average precipitation for the Oak Ridges station is slightly less than the 30-year normal of 32.2 inches. Also, approximately 15% of the average annual runoff of 9 inches measured at the Holland Landing gauge (02EC0019) consists of effluent discharges from Aurora and Newmarket sewage treatment plants.

ET is the difference between precipitation (P) and runoff (R). It represents water losses, of which the main components are considered to be evaporation and transpiration (ET).

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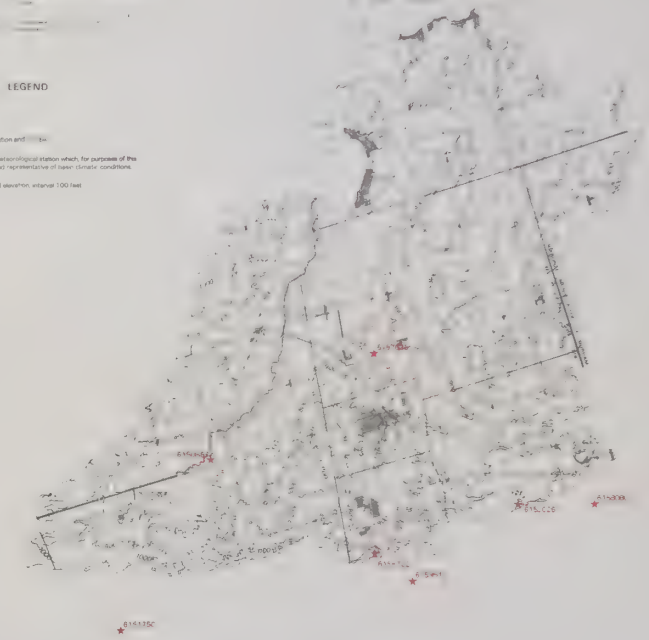
Cartography by D. Griffin and C. Mendy.

Base derived from 1:50 000 sheets of the National Topographic series.

TOPOGRAPHY

Scale 1 200 000



LEGEND

Meteorological station and [illegible]

The Oak Ridges meteorological station which, for purposes of this report, is considered representative of basin climatic conditions.

Contour of ground elevation, interval 100 feet

SUMMARY OF METEOROLOGICAL STATIONS

STATION NAME	STATION NUMBER	LAT °	LAT '	LONG °	LONG '	PERIOD OF RECORD AS OF 1977 Start	PERIOD OF RECORD AS OF 1977 End	DATA ON RECORD Temperature	DATA ON RECORD Precip. Value	DATA ON RECORD Rate of Rainfall
Bradford Springdale	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Active	[illegible]	[illegible]	
Bradford Wiltshire	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Active	[illegible]	[illegible]	
Cook Estate	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Active	[illegible]	[illegible]	
Oak Ridges	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Active	[illegible]	[illegible]	
Keswick	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Active	[illegible]	[illegible]	[illegible]
Kortright Waterfowl Park	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Active	[illegible]	[illegible]	
Stanton	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Active	[illegible]	[illegible]	
Willow Lake	6158519	43	57	79	26	1960	Active		X	X

Note: Meteorological stations that have operated intermittently in the past but were not in operation in 1977 are not listed.

CLIMATE

[illegible] Mesoscale [illegible] Peachey [illegible]

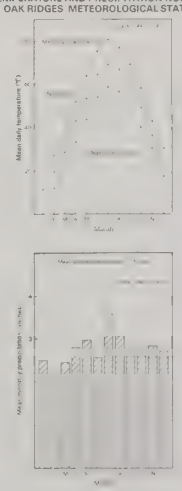
[illegible] Mean annual length of growing season

Range of growing season: April 18 to October 28

For purposes of this study, the Oak Ridges meteorological station is considered representative of local climatic conditions in the basin. This station has a long and consistent period of record in comparison with all other stations in and around the basin. The following statistics are derived from the Oak Ridges station:

Mean daily temperature	44.4°F
Mean daily maximum temperature	52.9°F
Mean daily minimum temperature	35.8°F
Mean annual precipitation	32.2 inches

TEMPERATURE AND PRECIPITATION NORMALS OAK RIDGES METEOROLOGICAL STATION



METRIC CONVERSION FACTORS

°F	(°F − 32) ÷ 1.8 = °C
1 mile	1.6 kilometres
1 foot	0.3 metres
1 square mile	2.6 square kilometres

Ontario

MINISTRY OF THE ENVIRONMENT

Water Resources Branch, Hydrology and Monitoring Section

WATER RESOURCES REPORT 15

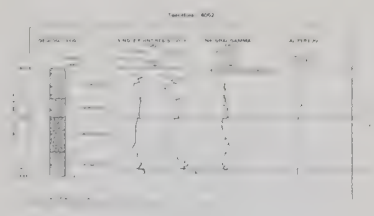
WATER RESOURCES OF THE HOLLAND AND BLACK RIVER BASINS

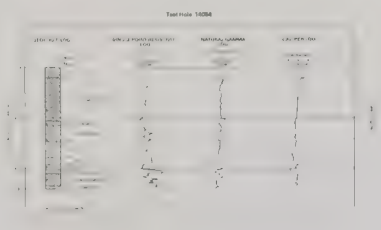
[illegible]

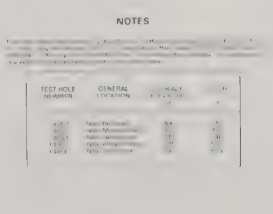
CLIMATE AND PHYSICAL SETTING

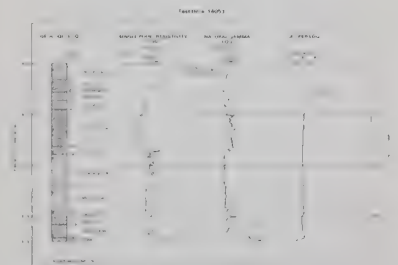
MAP 2247

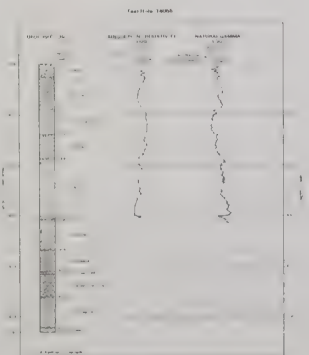
GEOLOGICAL AND GEOPHYSICAL WELL LOGS

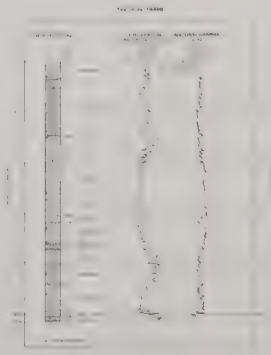












METRIC CONVERSION FACTORS

1 inch = 2.540 centimetres
1 foot = 0.3048 metres

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Base maps derived from 1:50 000 sheets of the National Topographic ...

MINISTRY OF THE ENVIRONMENT
Water Resources Branch
Hydrology and Monitoring Section

WATER RESOURCES REPORT 16

WATER RESOURCES OF THE HOLLAND AND BLACK RIVER BASINS

Sheet 2

LOCATIONS OF SELECTED WATER WELLS AND LOGS OF TEST HOLES

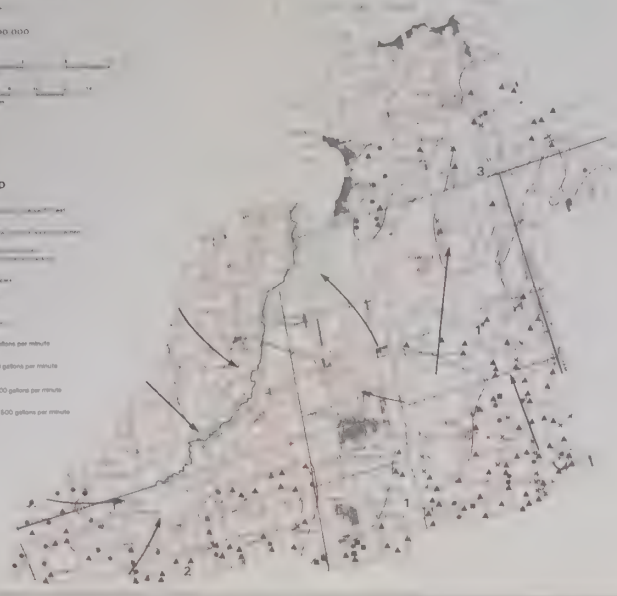
MAP 2248

AQUIFER COMPLEXES MAP A

Scale 1 200 000

LEGEND

- 1
- 2
- 3
- Probable well yield < 5 gallons per minute
- Probable well yield 5 50 gallons per minute
- Probable well yield 50 100 gallons per minute
- Probable well yield 100 500 gallons per minute



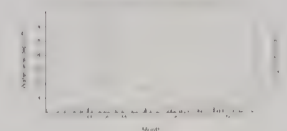
NOTES

Ridges Aquifer Complex (Turner 1977) consists of permeable sands
at depth between layers of
identified on these of the
or the water table
sands at a depth of 110 feet. On section

Water table contours indicate a northerly trend of shallow ground water move-
ment. There is a strong deflection of this movement toward the East Branch
Holland River and a weaker but less pronounced deflection towards the Black
Creek.

Of the five active observation wells in the basin, four are shallow wells that
indicate water table fluctuations. The hydrograph of observation well 340 is
considered representative and provides a record of water table levels for the period
from May 1971 to December 1976 in an aquifer in the Oak Ridges Aq
Complex. The 1972 section of this hydrograph is included in
illustration purposes, and shows typical seasonal trends in the late
water table in the spring and lower levels in late summer and fall. In 1972 the
water table fluctuated approximately 12 feet between water level depths of 12
and 24 feet.

M.O.E. OBSERVATION WELL 340



Month
1972

*Precipitation at Stouffville Meteorological station

HYDROGEOLOGIC CHARACTERISTICS OF AQUIFERS

MAP REF	AQUIFER NAME	THICKNESS RANGE	WATER BEARING CHARACTER	ELEVATION OF TOP OF WATER BEARING FORMATION RANGE (ft)	ELEVATION OF TOP OF WATER BEARING FORMATION AV (ft)	DEPTH TO STATIC WATER LEVEL RANGE (ft)	DEPTH TO STATIC WATER LEVEL AV (ft)	SATURATED THICKNESS MAX (ft)	SATURATED THICKNESS AV (ft)	SPECIFIC CAPACITY NO WELLS	SPECIFIC CAPACITY RANGE (gpm/ft)	SPECIFIC CAPACITY AV	TRANSMISSIBILITY RANGE (gpd/ft)	TRANSMISSIBILITY AVERAGE (gpd/ft)	PROBABLE YIELD RANGE (gpm)	PROBABLE YIELD AV (gpm)	GROUND WATER IN STORAGE AREA (mi²)	GROUND WATER IN STORAGE THICKNESS (ft)	GROUND WATER IN STORAGE (ft) (gal. × 10⁶)
			source of domestic supplies, yields of up to 300 gpm are obtained locally	850-1070	940	Flowing to 150	80	80	30	58	01-20	06	100-10 000	1 000	10-300	80	98	30	46
			source of domestic yields of up	800-1035	940	5-170	80	80	20	30	001-5	03							
															2-100	15			

AQUIFER COMPLEXES MAP B

Scale 1 200 000

LEGEND

- Piezometric surface elevation contour interval 50 feet
- General direction of ground water movement in an aquifer
- 4 Schomberg Aquifer Complex
- 5 Holt Aquifer Complex
- Probable well yield < 5 gallons per minute
- Probable well yield 5-50 gallons per minute
- Probable well yield 50-100 gallons per minute
- Probable well yield 100-500 gallons per minute

NOTES

The Schomberg Aquifer Complex in the west and the Holt Aquifer Complex in the east consist of formations of buried sands and gravels at elevations between 680 and 810 feet. Individual well yields in these two complexes are variable and are generally
per minute
which serves the
500 gallons per minute.

The
composed primarily of fine to medium
Complex shown for example on section C-C' in wells 10110, 525,
in this
This general movement of ground water in these complexes is in a northerly direction with slight deflections locally toward major river valleys. No hydrograph of water levels is available for aquifers in either of these complexes.

HYDROGEOLOGIC CHARACTERISTICS OF AQUIFERS

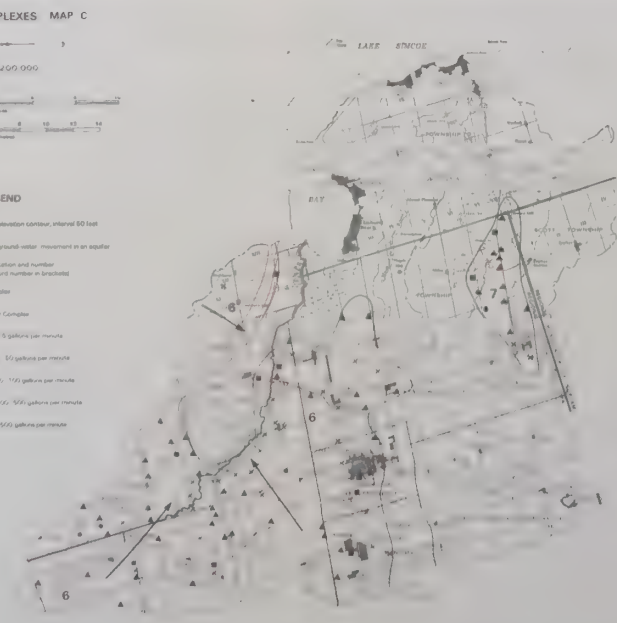
MAP REF	AQUIFER NAME	THICKNESS RANGE	WATER BEARING CHARACTER	ELEVATION OF TOP OF WATER BEARING FORMATION RANGE (ft)	ELEVATION OF TOP OF WATER BEARING FORMATION AV (ft)	DEPTH TO STATIC WATER LEVEL RANGE (ft)	DEPTH TO STATIC WATER LEVEL AV (ft)	SATURATED THICKNESS MAX (ft)	SATURATED THICKNESS AV (ft)	SPECIFIC CAPACITY NO WELLS	SPECIFIC CAPACITY RANGE (gpm/ft)	SPECIFIC CAPACITY AV	TRANSMISSIBILITY RANGE (gpd/ft)	TRANSMISSIBILITY AVERAGE (gpd/ft)	PROBABLE YIELD RANGE (gpm)	PROBABLE YIELD AV (gpm)	GROUND WATER IN STORAGE AREA (mi²)	GROUND WATER IN STORAGE THICKNESS (ft)	GROUND WATER IN STORAGE (ft) (gal. × 10⁶)
4	Alliston Aquifer Complex	sand and gravel	source of domestic and public suppliers, a yield of 1,200 gpm is obtained from a municipal well at Alliston	360-650	540	Flowing to 280	40	120	10	69	01-100	07	200-100,000	3800	10-1200	195	160	20	78
7	Mount Albert Aquifer Complex	sand and gravel	source of and public a yield of	600-730	670	Flowing to 95	30				0	1 6							

AQUIFER COMPLEXES MAP C

Scale 1 200 000

LEGEND

- surface elevation contour, interval 50 feet
- General direction of ground-water movement in an aquifer
- 347 (2951) Observation well location and number (MOE water well record number in brackets)
- 6 Alliston Aquifer Complex
- 7 Mount Albert Aquifer Complex
- Probable well yield < 5 gallons per minute
- Probable well yield 5-50 gallons per minute
- Probable well yield 50-100 gallons per minute
- Probable well yield 100-500 gallons per minute
- Probable well yield >500 gallons per minute



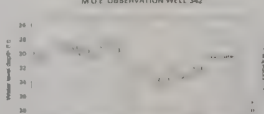
NOTES

Aquifers in the Alliston and Mount Albert complexes are found at elevations between approximately 380 and 730 feet. The Alliston Aquifer Complex (Turner 1978) is depicted in at least eight wells on section A-A' (716 709 693 4704 4705 7450 6624 8518). Considered a system of related aquifer lenses, the
at a series of primarily fine to coarse-grained sand aquifers
Estimated yields of wells in the Alliston Aquifer Complex are generally high. Yields of up to 1,200 gallons per minute are characteristic of a number of municipal wells in this complex in the vicinity of the towns of Aurora and Newmarket.

The Mount Albert Aquifer Complex consists primarily of deep sands and gravels averaging about 10 feet in thickness and is indicated for example in wells 11247 585, 578 and 13012 on section B-B'. Yields in wells in the Mount Albert Aquifer Complex are generally good, with one municipal well serving the community of Mount Albert rated at an estimated yield of 800 gallons per minute.

Lateral ground water movement in aquifers in these complexes is generally northerly, with local deflections toward major river valleys. The hydrograph of observation well 342 provides data of fluctuations of piezometric levels in the Alliston Aquifer Complex from February 1969 to December 1976. The numerous fluctuations on the 1972 section of the hydrograph reflect a piezometric response to the operation of the Church Street well serving the community of Bradford. In July 1970, an immediate decline in the piezometric level of between 25 and 35 feet was produced by the start up of pumping of the Church Street well. Since that time the piezometric surface has stabilized at a lower level and fluctuates generally between 21 and 31 feet below surface in spite of the effect of interference shown on the 1972 hydrograph seasonal trends in the hydrograph are normal, with high piezometric levels in mid-spring and lower levels in late summer and fall.

M.O.E. OBSERVATION WELL 342



*Precipitation at Bradford Pollution Water Age station

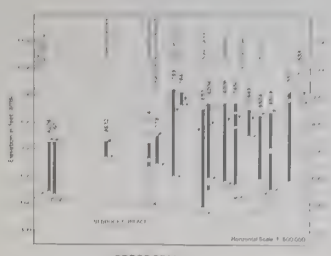
AQUIFER COMPLEXES

[illegible] water is obtained from a number of discrete water bearing [illegible] in the basin. In most cases these aquifers are not continuous over [illegible] together occur in individual areas that have limited extents. It is difficult to accurately identify these individual devices on the basis of [illegible] data. For this reason aquifer complexes have been mapped, which [illegible] hydraulically related aquifers (stratified [illegible] Locations, thicknesses and pressure levels of individual [illegible]

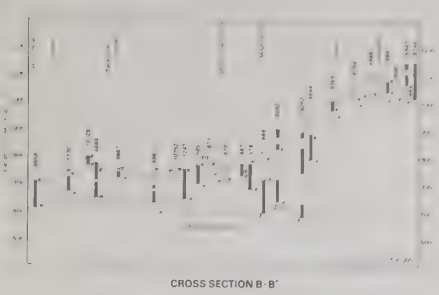
[illegible] aquifer complexes have been defined in this study and are shown, for purposes of clarity, on three separate maps sheets. The two major [illegible] basin, the Alliston and Oak Ridges aquifer complexes, have been previously defined by Sykes (1972, 1976). The interpretations of the extents and hydrogeologic characteristics of all aquifers are based on most recent available data. As additional hydrogeologic information becomes available, modifications may be necessary.

Hydrogeologic and well yield data are based on information provided by well drillers on well records submitted to the Ministry. Due to lack of certain data on the well records for some wells, the aquifer maps portray only a portion of the wells in each aquifer.

Most wells in the basin have been developed to serve small domestic needs. Therefore, the wells do not penetrate the aquifers fully and are usually not developed to yield the maximum amounts of water possible from each aquifer. As a result, the individual well yields indicated on the maps and associated tables are considered conservative. Where large quantities of water are required for future development, local hydrogeologic investigations should be carried out to determine the full potential of aquifers at specific locations.



CROSS SECTION A - A'



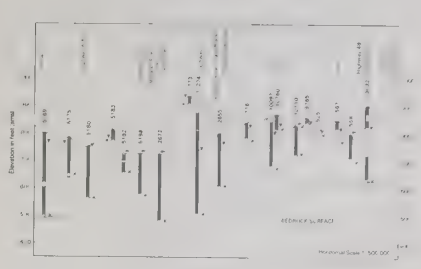
CROSS SECTION B - B'

HYDROGEOLOGIC CROSS SECTIONS

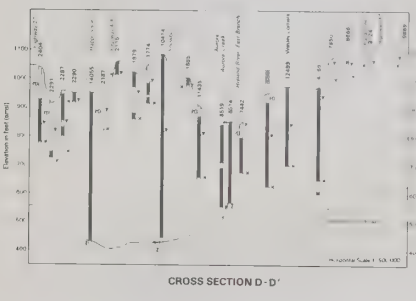
LEGEND

- Clay till
- Sand, gravel
- Limestone
- Shale
- Static water level
- Depth at which water was found
- Flowing well
- Previously dug
- 4208 MOE test hole or water well number

Note: Locations of cross sections appear on Sheet 2



CROSS SECTION C - C'



CROSS SECTION D - D'

SUMMARY OF OBSERVATION WELL DATA

OBSERVATION WELL NUMBER	MOE WATER WELL NUMBER	WELL TYPE	WELL DIAMETER (in)	WELL DEPTH (ft)	SURFACE ELEVATION (ft)	PERIOD OF RECORD AS OF 1977 Start	End	WATER BEARING FORMATION	McDIAN WATER LEVEL DEPTH (Period of Record) (ft)	RANGE OF WATER LEVEL DEPTHS (ft below surface)
340	10965	Bored	48	29	981	May '71	Active	Sand	21	3.9 to 25.0
342	2666	Drilled	5	305	722	Feb '69	Active	Coarse Sand	31	20.5 to 37.3[1]
343	10967	Bored	36	12	721	Jun '71	Active	Sand	5	1.5 to 9.2
527	13678	Bored	36	13	730	Nov '76	Active	Sand	4	2.2 to 10.2
528	491	Bored	36	18	825	Nov '76	Active	Quick Sand	4	1.9 to 7.3

[1] Range is of water levels recorded after the start of pumping of the nearby Bradford Church Street Well (8791) in July 1970.

METRIC CONVERSION FACTORS

1 inch	2.540 centimetres
1 foot	0.3048 metres
1 mile	1.609 kilometres
1 square mile	2.590 square kilometres
1 gallon	4.546 litres
1 gallon per minute	0.7576×10^{-3} litres per second
1 gallon per day	5.701×10^{-6} litres per second
1 million gallons per day	52.61 litres per second
1 gallon per day per foot	14.90 litres per day per metre
1 gallon per day per square foot	40.91 litres per day per square metre
1 cubic foot per second	28.32 litres per second

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1977. Alliston aquifer complex. MOE, Water R[illegible] Hydrology, Map 77-1.

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Water well records on file with the Ministry as of the end of 1977.

Cartography by: Long and D. Griffin.

Base map derived from 1:50,000 sheets of the National Topographic series.

Ontario

MINISTRY OF THE ENVIRONMENT

Water Resources Branch
Hydrology and Monitoring Section

WATER RESOURCES REPORT 16

WATER RESOURCES OF THE HOLLAND AND BLACK RIVER BASINS

Sheet 3

AVAILABILITY OF GROUND WATER

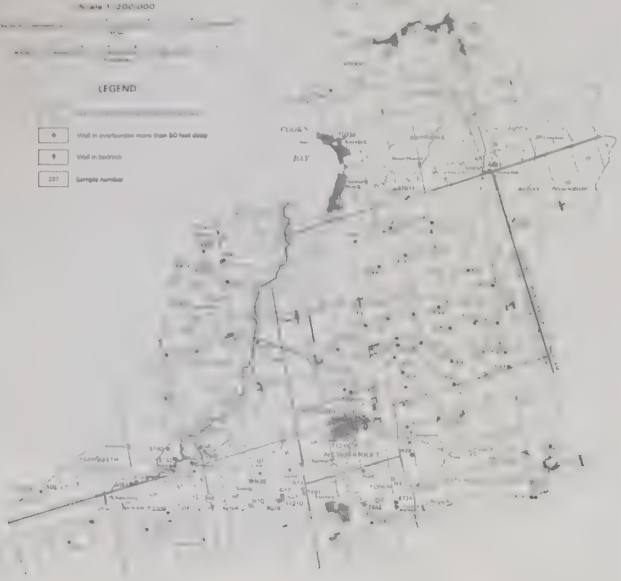
MAP 2249

SAMPLE LOCATIONS

Scale 1 200 000

LEGEND

- Well in overburden more than 50 feet deep
- Well in bedrock
- Sample number

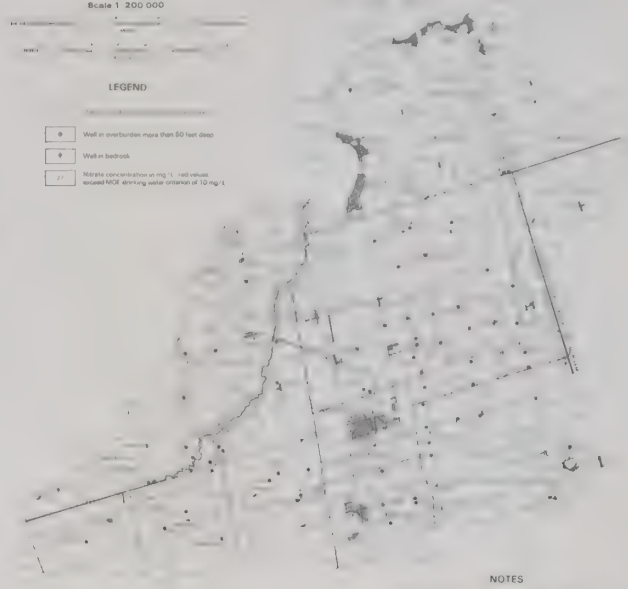


NITRATE

Scale 1 200 000

LEGEND

- Well in overburden more than 50 feet deep
- Well in bedrock
- Nitrate concentration in mg/L, red values exceed MOE drinking water criterion of 10 mg/L



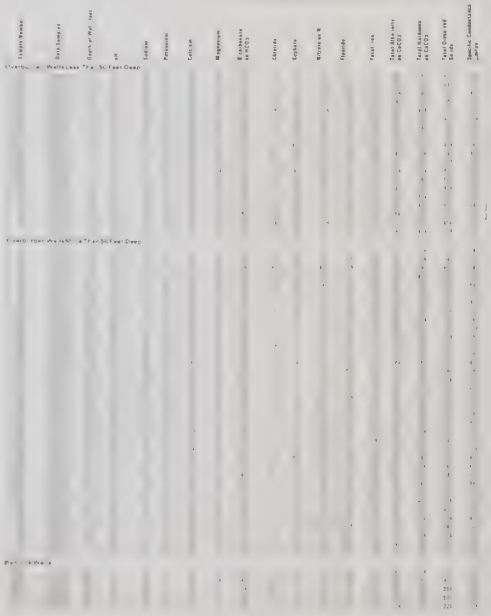
NITRATE IN GROUND WATER, 1978

Sample Number	Date Sampled	Depth of Well (ft)	Nitrate as N (mg/l)	Specific Conductance (umhos)
Overburden Wells Less Than 50 Feet Deep				
Overburden Wells More Than 50 Feet Deep				

NOTES

INORGANIC CHEMICALS, 1977 - 1978

Constituents in milligrams per litre (mg/L)



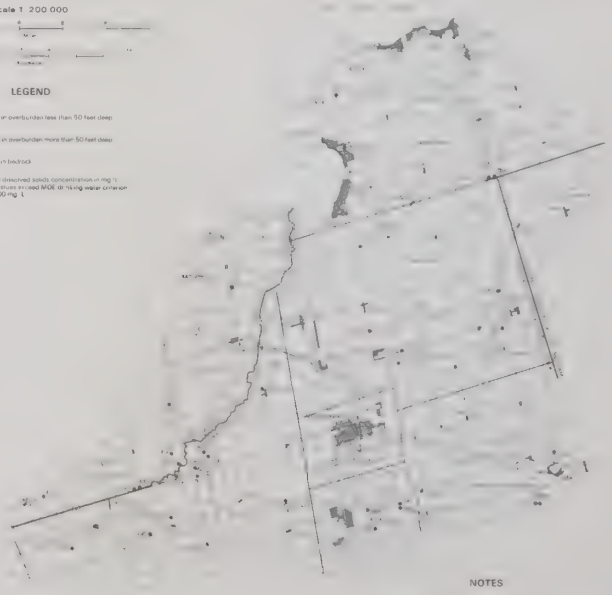
TOTAL DISSOLVED SOLIDS

Scale 1 200 000

LEGEND

- Well in overburden less than 50 feet deep
- Well in overburden more than 50 feet deep
- Well in bedrock

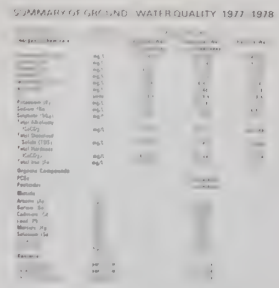
Total dissolved solids concentration in mg/L, red values exceed MOE drinking water criterion of 500 mg/L



NOTES

Ground water in the basin is moderately mineralized. The total dissolved solids (TDS) content of samples ranged from 217 to 880 mg/L. The mean value is 424 mg/L. High TDS values are notable near the village of Sharon and north and west of it.

SUMMARY OF GROUND WATER QUALITY 1977 - 1978



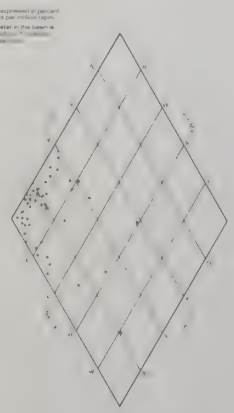
MAJOR ION CHEMISTRY

LEGEND

- Well in overburden more than 50 feet deep
- Well in bedrock

Note: All values expressed in percent equivalents per million (epm).

Ground water in the basin is



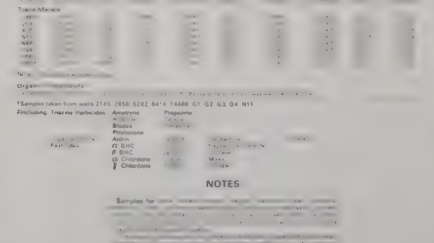
BACTERIAL QUALITY, 1977

COUNT / 100ml

SAMPLE NUMBER	APR	MAY	JUN
237	4	2	0
308	0	0	0
400	0	0	0
2145	0	0	0
2037	0	0	0
2058	0	0	0
8282	0	0	0
8321	0	0	0
8414	0	0	0
8860	0	0	0
9210	0	0	0
9300	0	0	0
11210	0	0	0
	0	0	0
	0	0	0
	0	0	0
	0	0	0
	>2400	0	0

NOTES

TRACE METALS AND ORGANIC COMPOUNDS 1977



Trace Metals

Organic Compounds

¹Samples taken from wells 2145, 2058, 8282, 8414, 10488, G1, G2, G3, G4, N11

²Including Triazine Herbicides: Ametryne, Prometone, Atrazine, Bladex, Prometone, Aatrex, α BHC, β BHC, Chlordane, Heptachlor

NOTES

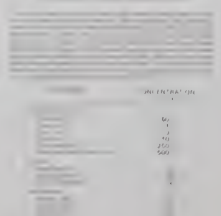
Samples for

METRIC CONVERSION FACTORS

From	To	Multiply by

SELECTED REFERENCES

WATER QUALITY OBJECTIVES



MINISTRY OF THE ENVIRONMENT
Water Resources Branch
Hydrology and Monitoring Section

WATER RESOURCES REPORT 15

WATER RESOURCES OF THE HOLLAND AND BLACK RIVER BASINS

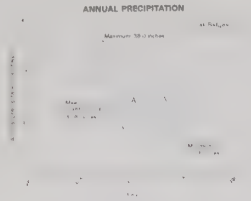
Sheet 4

QUALITY OF GROUND WATER

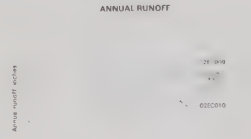
MAP 2290

ANNUAL PRECIPITATION AND RUNOFF

ANNUAL PRECIPITATION



ANNUAL RUNOFF



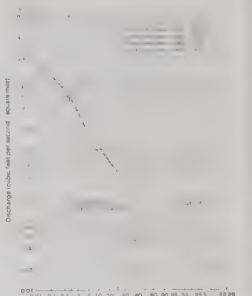
NOTES

An average annual runoff of 8.8 inches is estimated for stations 02EC009 on the East Branch Holland River and 02EC008 (02EC012 combined) on the Black River for their respective periods of record from 1966 to 1976 and 1965 to 1976. A portion of the annual runoff measured at station 02EC009 is contributions from sewage treatment plants at Aurora and Newmarket. An average annual runoff of 9.7 inches for the period from 1967 to 1976 is estimated for station 02EC010 on the Holland River. Annual precipitation for the period from 1956 to 1976 at the Oak Ridges station, which is considered representative for the basin, is 31.6 inches.

ANNUAL RUNOFF DATA SUMMARY

STATION PERIOD	02EC009 1966 - 1976 (in)	02EC010 1967 - 1976 (in)	02EC008 and 02EC012 1965 - 1976 (in)
Mean	8.8	9.7	8.7
Maximum	10.8	12.1	12.5
Minimum	6.2	4.1	5.4

Holland River at Schomberg (02EC010)
East Branch Holland River at Holland Landing (02EC009)
Black River at Bakiwin (02EC008) and Black River at Sutton (02EC012) combined



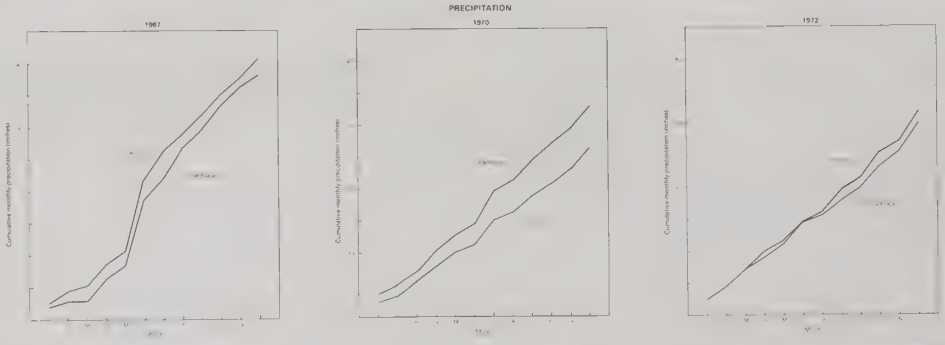
Percentage of time indicated discharge was equalled or exceeded

* Excluding 1968 data not available

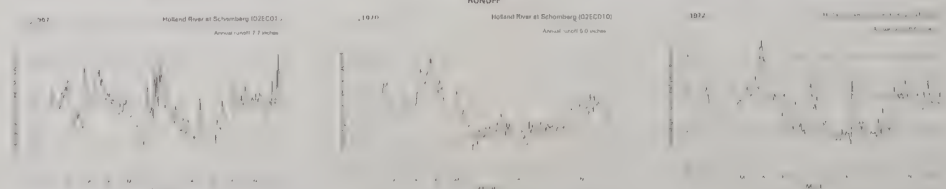
Flow duration curves for the long term stations on the East Branch Holland River (02EC009), the Holland River (02EC010) and the Black River (02EC008 and 02EC012 combined) are generally similar in the high flow regions of the curves but diverge in the low flow regions. The curve for station 02EC009 on the East Branch Holland River at Holland Landing, which shows the highest discharge per square mile in the one hour region of the curve, incorporates discharges from sewage treatment plants (STP) at Aurora and Newmarket which are upstream of the gauge.

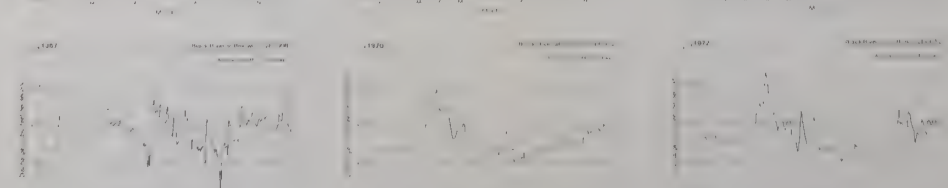
DAILY PRECIPITATION AND RUNOFF

PRECIPITATION

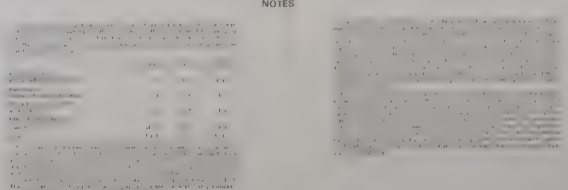


RUNOFF



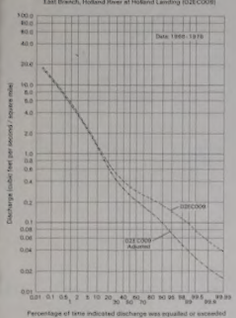


NOTES

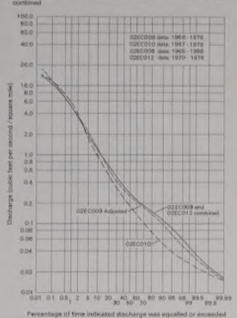


FLOW-DURATION CURVES

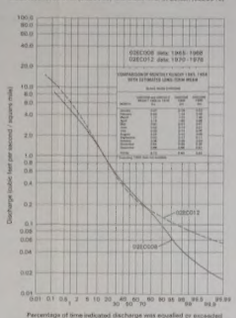
East Branch, Holland River at Holland Landing (02EC008)



East Branch, Holland River at Holland Landing (02EC009) Adjusted: Excluding STP contributions
Holland River at Schomberg (02EC010)
Black River at Baldwin (02EC008) and Black River at Sutton (02EC012), combined



Black River at Baldwin (02EC008) and Black River at Sutton (02EC012)



NOTES

While the exact flow-duration curve for the East Branch, Holland River at Holland Landing, exclusive of STP discharges, cannot be constructed because actual STP discharge values are not available from 1966 to 1970, it is felt that the estimated curve labelled "02EC009 Adjusted" is a good approximation. Between the 10 and 90 percent flow range (flows that were 90 percent (measured) flows less than 90 cfs), the curve should be considered poor; this is because the stage-discharge relationship at Holland Landing is poorly defined below 10 cfs. The whole curve was synthesized by using an approximate estimated value of 8 cfs for STP discharges for the period 1966 to 1976, and subtracting this value from the measured flows at station 02EC009. It was also assumed that the discharge, per square mile, at Holland Landing (exclusive of STP discharges) would be no less than discharges at the other long-term stations on the Holland and Black rivers.

After excluding the STP contributions, the flow-duration curve for station "02EC009 Adjusted" shows a closer similarity to the other flow-duration curves.

The flow-duration curve for the Black River (02EC008 and 02EC012 combined) is a combination of data from stations 02EC008 and 02EC012. Station 02EC008 on the Black River at Baldwin was operated from 1965 to mid-1968. It was replaced by station 02EC012 at Sutton, which provides complete records for the period 1970 to 1978. The curves for these two stations are dissimilar in the low-flow region. This discrepancy is attributed to runoff differences during the two operating time periods. While average annual runoff during the two operating periods is not significantly different (6.4 inches for 1965 to 1968 and 6.8 inches for 1970 to 1976), the runoff for the driest year of record, which was in 1965 (5.8 inches) and 1966 (5.9 inches) are the most nearest to the lowest daily discharges at station 02EC008. A comparison of monthly runoff at station 02EC008 for the years 1965 and 1966, with the long-term mean (1965-1976) as estimated by data from stations 02EC008 and 02EC012, shows the consistency with which runoff remained below average at station 02EC008 during these two years.

STREAMFLOW DATA

NOTES

Data from 19 streamflow gauging stations with both intermittent and long-term records were used in the analysis of surface-water quantity in the study area. All stations are located on the low-flow map and summarized in tabular form.

Four stations with relatively long-term and consistent records are located in the basin. These stations are 02EC009 on the East Branch, Holland River at Holland Landing, 02EC010 on the Holland River at Schomberg, 02EC008 on the Black River at Baldwin and 02EC012 on the Black River at Sutton. Station 02EC008, recording from 1965 to 1968, was replaced in 1970 by station 02EC012 for which a complete record is available to 1976. For the purposes of this study, data for these two stations have been integrated to form a single 11-year record of flows at the Black River at Sutton (02EC012).

Although continuous streamflow records in the basin are available since 1965, these records, in a hydrologic sense, are relatively short. A comparison of the annual runoff for the Black River (02EC008 and 02EC012 combined) for the period 1965 to 1976, with the record for the nearby station on the East Humber River near Pine Grove (02HC009) for the period from 1954 to 1978 indicates why streamflow data in the Holland-Black basin is inadequate for purposes of long-term hydrologic analyses. For example, extremely high and low runoffs that occurred in the general area are evident in the longer records of the East Humber River just southwest of the study area. The extremely high runoff that resulted from Hurricane Hazel in 1954, and the extremely low annual runoffs that resulted from below normal precipitation in 1962, 1963 and 1964, are examples of significant hydrologic events not contained in the streamflow records for the Holland-Black basin.

Period of record for the Black River compared to the long-term record for the East Humber River

SUMMARY OF STREAMFLOW GAUGING STATIONS WITH INTERMITTENT RECORDS

STREAM	STATION NUMBER	DRAINAGE AREA (mi²)	DATA PUBLISHED IN OWRC AND MOE WATER RESOURCES BULLETINS '70	'71	'72	'73	'74	'75	'76
Aurora Creek near Aurora	02EC108	11.8				X	X		
Aurora Creek near Aurora	02EC100	15.1	X						
Black River near Binam Hill (above confluence)	02EC106	47.4	X	X	X	X			
Black River near Brown Hill (below confluence)	1		X	X		X			
Black River at Cedar Valley	02EC110	4.4							X
Black River near Pine Orchard	02EC111	6.2							X
Black River near Sharon	02EC112	15.3							X
Black River near Sharon	2		X	X	X	X	X		
Bogart Creek at Newmarket	3		X	X	X	X	X		
East Branch, Holland River near Aurora	02EC107	22.3	X	X	X				
East Branch, Holland River at Newmarket	4		X	X	X	X	X		
Maskinonge River near Ravenshoe	5					X	X		
Mount Albert Creek near Mount Albert (above confluence)	02EC113*	24.3	X	X	X	X	X		
Mount Albert Creek near Mount Albert (below confluence)	6			X					
Vivian Creek near Mount Albert	7			X					

*Also referred to as 02EC104 prior to 1978

NOTES

The low-flow map is based on data at the following long-term streamflow stations in the basin: The Holland River near Schomberg (02EC010); the East Branch, Holland River at Holland Landing (02EC009); the Black River at Baldwin (02EC008); and the Black River at Sutton (02EC012). All other streamflow stations have shorter-term records which were correlated with data at the long-term stations to estimate average low flows for the 1965 to 1976 period for the Maskinonge and other small sub-basins draining directly to Lake Simcoe. For purposes of the map, low flow is assumed to be daily discharge exceeded 90% of the time.

Low-flow yields from the two largest contributors, the Black River basin and the East Branch, Holland River basin, are almost the same --0.12 and 0.10 cfs per square mile, respectively. Low flows for the East Branch, Holland River basin are relatively constant between treatment plants at Aurora and Newmarket.

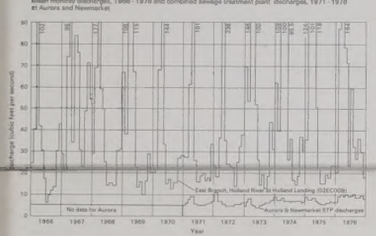
Data are not available for the lower reaches of the Holland River because backwater effects from Cook Bay make streamflow measurement impractical.

SUMMARY OF STREAMFLOW GAUGING STATIONS WITH LONG-TERM RECORDS

STREAM	STATION NUMBER	DRAINAGE AREA (mi²)	TYPE OF GAUGE	PERIOD OF CONTINUOUS RECORD AS OF 1977 START	END	AVERAGE DAILY FLOW (cfs) MAXIMUM	MEAN	MINIMUM	REMARKS
Black River at Baldwin	02EC008	120	Recording	1965	1968	1150 (Feb. 11/65)	74.1 (4 years)	2.2 (Sep. 17/68)	Regulated Flow
Black River at Sutton	02EC012	123	Recording	1970	Active	2170 (Apr. 14/72)	84.8 (7 years)	1.9 (Jul. 17/74)	Regulated Flow
East Branch, Holland River at Holland Landing	02EC009	97.8	Recording	1965	Active	1360 (Feb. 24/70)	43.8 (11 years)	2.6 (Sep. 29/73)	Natural Flow
Holland River near Schomberg	02EC010	19.8	Recording	1966	Active	322 (Apr. 13/72)	10.0 (10 years)	0.30 (Jul. 26/67)	Natural Flow

EFFECTS OF EFFLUENT DISCHARGES ON STREAMFLOWS IN THE EAST BRANCH, HOLLAND RIVER

Mean monthly discharges, 1966-1978 and combined sewage treatment plant discharges, 1971-1976 at Aurora and Newmarket

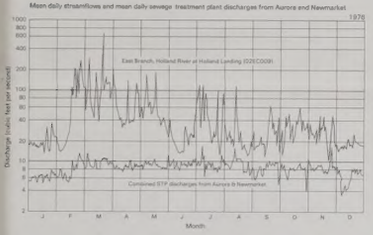


NOTES

Effluent discharges into the East Branch, Holland River from sewage treatment plants (STPs) at Aurora and Newmarket are incorporated in measured stream-flows at gauging station 02EC009 at Holland Landing. Records of effluent discharges are not available for the entire period of streamflow record at this station; however, the available records (1971 to 1976) for the two STPs indicate that every-year average annual discharge is be 8.0 cfs, or about 15% of the average annual streamflow of 45.9 cfs at Holland Landing for the corresponding period.

A comparison of monthly discharges indicates that STP discharges are a significant portion of the East Branch, Holland River flows during the summer months of June to September. STP discharges for these months in the years 1971 to 1976 ranged between 16 and 44 percent of measured flows. STP discharges during September were consistently greater than 30% of the measured flows, ranging between 32 and 44 percent. To depict this relationship, the 1978 hydrograph indicates the significance of the STP discharges, especially during the late summer and early fall, relative to total streamflow in the East Branch, Holland River at Holland Landing.

Mean daily streamflows and mean daily sewage treatment plant discharges from Aurora and Newmarket



AVERAGE ANNUAL DISCHARGES FROM SEWAGE TREATMENT PLANTS

YEAR	AURORA ANNUAL DISCHARGE (cfs)	NEWMARKET ANNUAL DISCHARGE (cfs)	TOTAL ANNUAL DISCHARGE (cfs)
1966	NA	2.8	NA
1967	NA	3.1	NA
1968	NA	2.7	NA
1969	NA	3.1	NA
1970	NA	3.0	NA
1971	2.8	3.2	6.0
1972	2.9	3.7	6.6
1973	3.3	3.3	6.6
1974	3.2	3.6	6.8
1975	2.8	3.7	6.5
1976	3.9	4.8	8.7
AVERAGE*	3.2	3.7	6.9

NA - Data not available
* - Average for period 1971 to 1976

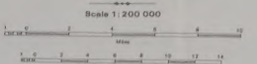
MONTHLY STP DISCHARGES AS A PERCENTAGE OF TOTAL STREAMFLOWS DURING THE SUMMER MONTHS

YEAR	JUNE	JULY	AUGUST	SEPTEMBER	AVERAGE[1]
1971	41	31	30	38	35
1972	30	34	34	41	35
1973	24	36	30	44	34
1974	25	18	29	34	26
1975	29	30	35	32	33
1976	39	16	31	32	30
AVERAGE[2]	31	28	32	37	32

1 Average of June to September flows
2 Average flows - 1971 to 1976

LOW FLOWS AS INDICATED BY DAILY DISCHARGES EXCEEDED 90% OF THE TIME

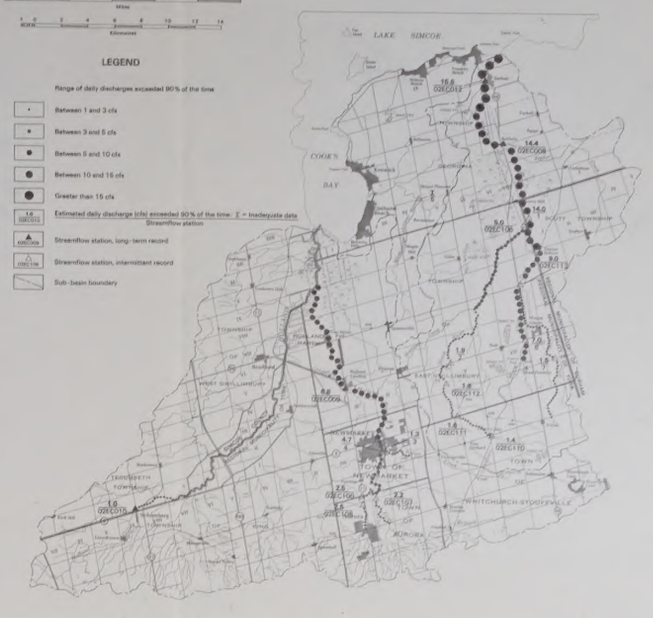
Scale 1:200 000



LEGEND

Range of daily discharges exceeded 90% of the time

- Between 1 and 3 cfs
- Between 3 and 6 cfs
- Between 6 and 10 cfs
- Between 10 and 16 cfs
- Greater than 16 cfs
- Estimated daily discharge (cfs) exceeded 90% of the time; Σ = inadequate data
- Streamflow station, long-term record
- Streamflow station, intermittent record
- Sub-basin boundary



MAJOR SUB-BASIN ESTIMATED LOW FLOWS

SUB-BASIN	AREA (mi²)	90% EXCEEDANCE (cfs)	(cfs / mi²)	ANNUAL EQUIVALENT (cfs)
Holland[1]	138	0	0.04	0.6
The East Branch, Holland[2]	92	10	0.11	1.5
Maskinonge[2]	21	1	0.05	0.7
Direct Drainage[3]	24	1	0.05	0.7
Black	128	15	0.12	1.6
ALL SUB-BASINS	404	33	0.08	1.1

[1] Very little information is available: estimates are based on data from Station 02EC010 covering 19.8 square miles.
[2] Excludes discharges from sewage treatment plants.
[3] No available data; estimates are based on data from Station 02EC010.

NOTES

The low-flow map is based on data at the following long-term streamflow stations in the basin: The Holland River near Schomberg (02EC010); the East Branch, Holland River at Holland Landing (02EC009); the Black River at Baldwin (02EC008); and the Black River at Sutton (02EC012). All other streamflow stations have shorter-term records which were correlated with data at the long-term stations to estimate average low flows for the 1965 to 1976 period for the Maskinonge and other small sub-basins draining directly to Lake Simcoe. For purposes of the map, low flow is assumed to be daily discharge exceeded 90% of the time.

Low-flow yields from the two largest contributors, the Black River basin and the East Branch, Holland River basin, are almost the same --0.12 and 0.10 cfs per square mile, respectively. Low flows for the East Branch, Holland River basin are relatively constant between treatment plants at Aurora and Newmarket.

Data are not available for the lower reaches of the Holland River because backwater effects from Cook Bay make streamflow measurement impractical.

ANNUAL MAXIMUM DAILY DISCHARGES

NOTES

Frequency curves of annual maximum daily discharges show the average recurrence intervals for specific discharges. Maximum daily discharges are highest for the Black River and lowest for the Holland River.

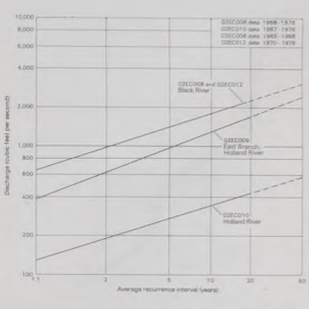
Discharges per square mile, based on the Q_{50} values, range between 23.3 cfs/mi² and 39.4 cfs/mi², being lowest for the Black River sub-basin and highest for the East Branch, Holland River sub-basin. Discharges based on the $Q_{2.33}$ values range between 7.8 and 10.7 cfs/mi².

Variations in high flows can be measured by the "index of variance", defined as $Q_{50}/Q_{2.33}$ where Q_{50} and $Q_{2.33}$ are the annual maximum daily discharges with annual recurrence intervals of 50 and 2.33 years, respectively. The indices for the three stations are generally similar, ranging between 2.9 to 3.5.

A discussion of maximum daily discharges relative to flooding has not been included in this report. The Regional Municipality of York and the South Lake Simcoe Conservation Authority have been active in commissioning floodline studies throughout the basin. Historical flooding problems are discussed in the South Lake Simcoe Conservation Report (1973).

ANNUAL MAXIMUM DAILY DISCHARGES AND INDICES OF VARIATION

AVERAGE RECURRENCE INTERVAL (yrs)	DISCHARGES HOLLAND (EAST BRANCH) GAUGE 02EC009 (cfs)	(cfs / mi²)	HOLLAND (EAST BRANCH) GAUGE 02EC009 (cfs)	(cfs / mi²)	BLACK GAUGES 02EC008 & 02EC012 (cfs)	(cfs / mi²)
50	3800	39.2	2400	35.4	3000	23.3
2.33	1200	10.1	800	10.0	1000	7.8
Index of Variation	2.9		3.5		3.0	



METRIC CONVERSION FACTORS

1 inch	=	2.540 centimetres
1 mile	=	1.609 kilometres
1 square mile	=	2.590 square kilometres
1 cubic foot per second	=	0.02832 cubic metres per second
1 cubic foot per second per square mile	=	0.01093 cubic metres per second per square kilometre
1 million gallons per day	=	4.546 million litres per day

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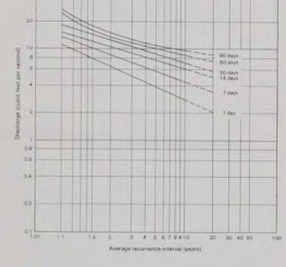
Cartography by D. Griffin

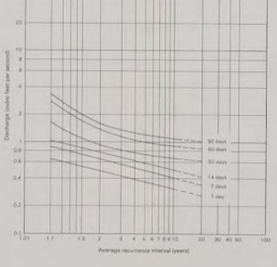
Base map derived from 1:50 000 sheets of the National Topographic series.

ANNUAL MINIMUM DAILY DISCHARGES

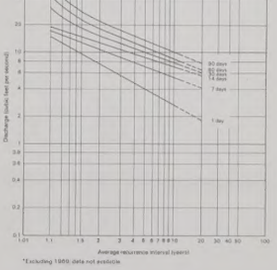
East Branch, Holland River at Holland Landing (02EC009)



Holland River at Schomberg (02EC010)



Black River at Baldwin (02EC008) and Black River at Sutton (02EC012), combined*



*Excluding 1969; data not available

NOTES

Frequency curves of annual minimum daily discharges show the average recurrence intervals for specified discharges. Discharges from sewage treatment plants at Aurora and Newmarket are included in the curves for station 02EC009 on the East Branch, Holland River at Holland Landing.

The 7-day Q_{10} is a common value used in waste assimilation studies, and is defined as the mean 7-day discharge that occurs, on the average, once in 10 years, or that has a five percent chance of occurring over a long period of time. Values of 7-day Q_{10} obtained from the frequency curves are: 3.5 cfs for the East Branch, Holland River (02EC009); 0.34 cfs for the Holland River (02EC010); and 4.2 cfs for the Black River (02EC008 and 02EC012 combined). On a per square mile basis, the largest 7-day Q_{10} of 0.052 cfs per square mile applies to the East Branch, Holland River station, while 0.017 and 0.033 cfs per square mile apply to the Holland and Black River stations, respectively.

Ontario

MINISTRY OF THE ENVIRONMENT
Water Resources Branch
Hydrology and Monitoring Section

WATER RESOURCES REPORT 15

WATER RESOURCES OF THE HOLLAND AND BLACK RIVER BASINS

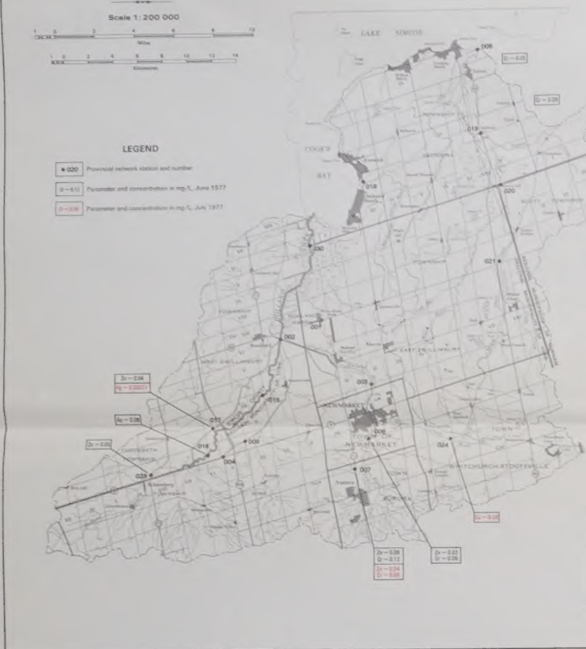
Sheet 5

SURFACE – WATER HYDROLOGY

MAP 2281

TRACE METALS

Scale 1 : 200 000



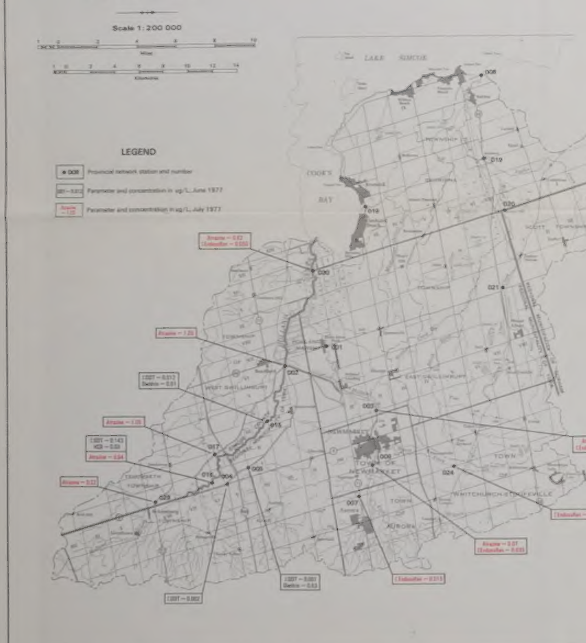
NOTES

SUMMARY OF TRACE METAL ANALYSES, JUNE – JULY, 1977

RANGE OF VALUES (mg/L)

ORGANIC COMPOUNDS

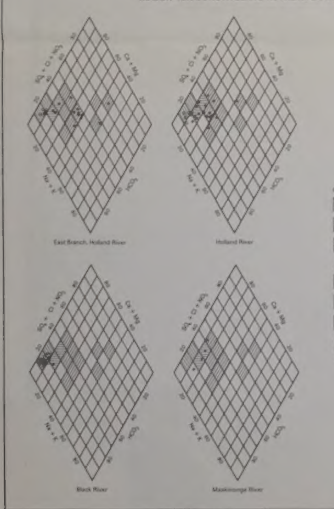
Scale 1 : 200 000



NOTES

SUMMARY OF ORGANIC COMPOUNDS, JUNE–JULY, 1977

MAJOR-ION CONSTITUENTS IN THE MAJOR SUB-BASINS



LEGEND

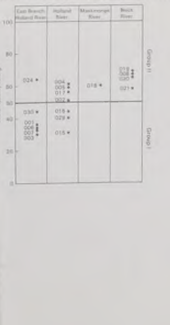
MAJOR-ION CONSTITUENTS BY ZONES IN THE MAJOR SUB-BASINS

GENERAL WATER QUALITY

Scale 1 : 200 000

LEGEND

RELATIVE POSITIONS OF THE PROVINCIAL NETWORK STATIONS ON THE WATER QUALITY RATING SCALE, 1977



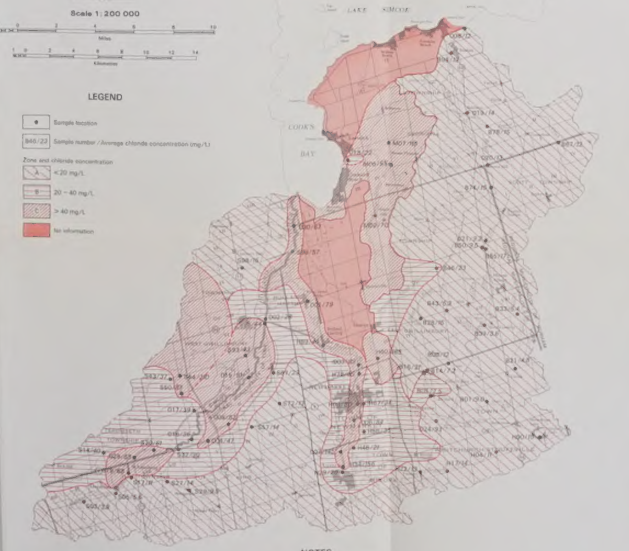
NOTES

SUMMARY OF WATER QUALITY RATINGS AND DATA, 1977

BACKGROUND QUALITY OF STREAMS

Scale 1 : 200 000

LEGEND



NOTES

ESTIMATED ANNUAL TRIBUTARY LOADINGS TO LAKE SIMCOE, 1976

NOTES

ESTIMATED ANNUAL SEWAGE TREATMENT PLANT LOADINGS TO THE EAST BRANCH, HOLLAND RIVER, 1976

NOTES

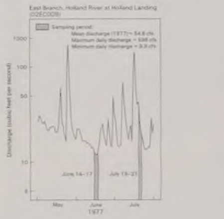
METRIC CONVERSION FACTORS

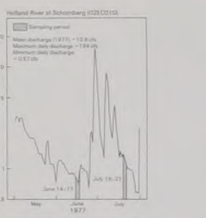
WATER QUALITY DATA

WATER QUALITY ANALYSES

NOTES

SAMPLING PERIODS AS SHOWN AT GAUGING STATIONS 02EC009 AND 02EC010





SUMMARY OF WATER QUALITY ANALYSES, 1977

SUMMARY OF PROVINCIAL WATER QUALITY NETWORK STATIONS

PROVINCIAL WATER QUALITY OBJECTIVES

SELECTED REFERENCES

Ontario

MINISTRY OF THE ENVIRONMENT
Water Resources Branch
Hydrology and Monitoring Section

WATER RESOURCES REPORT 16

WATER RESOURCES OF THE HOLLAND AND BLACK RIVER BASINS

Sheet 6

QUALITY OF SURFACE WATERS, 1977

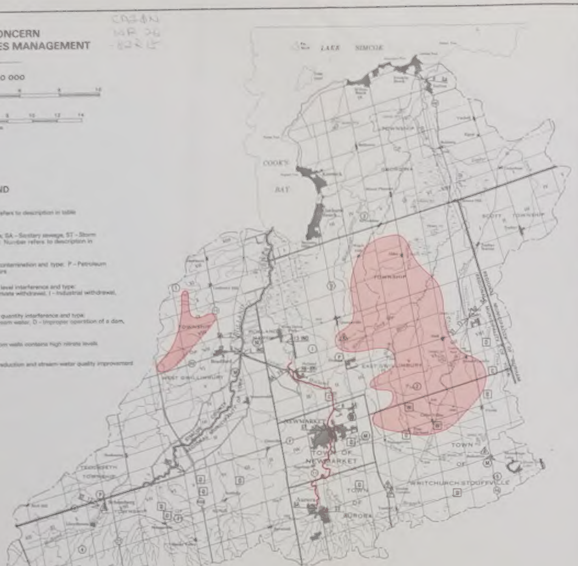
MAP 2252

SITES OF CONCERN TO WATER RESOURCES MANAGEMENT

Scale 1: 200 000

Miles

Kilometres



LEGEND

- Sanitary landfill site. Number refers to description in table 'Sanitary Landfill Sites'
- Waste discharge point and type; SA – Sanitary sewage, ST – Storm sewage, IND – Industrial waste. Number refers to description in table 'Waste Discharges'
- Site of reported ground-water contamination and type: P – Petroleum products, S – Salt, A – Agriculture
- Site of reported ground-water level interference and type: M – Municipal withdrawal, P – Private withdrawal, I – Industrial withdrawal, D – Construction dewatering
- Site of reported surface-water quantity interference and type: W – Excessive withdrawal of stream water, D – Improper operation of a dam, C – Construction activity
- Area in which ground water from wells contains high nitrate levels
- Zone of potential streamflow reduction and stream-water quality improvement

NOTES

Sites of concern to water resources management refer to locations where conditions of water or land use may affect the quantity or quality of water in the basin. Sanitary landfill sites and waste discharge points are routinely mapped as potential sites of concern, although no problems may be associated with these now or in the future. In a similar way, sites of past cases of surface- or ground-water quantity or quality interference have been located to indicate past problems.

Three issues of water management in the basin are highlighted. First, high levels of nitrates in ground water have been reported in two areas in the basin. The reasons for the high levels have not been investigated but they are likely attributable to normal agricultural activities in these areas.

Second, the York-Durham sewerage system will be completed by the mid-1980's, serving the towns of Aurora and Newmarket and eliminating the discharge from the existing sewage treatment plants into the East Branch of the Holland River. While providing increased servicing capacity and improving the water quality in the East Branch, Holland River downstream of these plants, the servicing will also result in the reduction of streamflows in the river. What effects the improved water quality and reduced flow will have on downstream uses are not known.

Third, in the upstream areas of the basins the dominant surface-water quantity problem is the improper operation of a large number of dam-formed ponds which have been constructed in association with a trend to rural-estate residential development. Such impoundments not only reduce low flows, often critically in summer, but can contribute to water quality impairment.

SANITARY LANDFILL SITES

Map Reference	Site Name	Major Contributors
1	York Sanitation	Twp. of West Gwillimbury – Town of Bradford – population served: 10,000 – agricultural and domestic wastes
2	York Sanitation	Twp. of East Gwillimbury – population served: 5,000 – domestic waste (80%) – 20 acres
3	Georgina Twp. Site #1	Twp. of Georgina/Sutton – population served: 12,250 – domestic waste (78%) – 50 acres
4	King Township	Twp. of King – population served: 5,500 – domestic waste (90%) – 28 acres
5	York Sanitation #4	Town of Whitchurch-Stouffville – industrial waste (24%) – commercial and domestic (60% combined) – 195 acres

WASTE DISCHARGES

Map Reference	Municipality / Community	Receiving Body	Waste Source Treatment	Discharge (1976)
1	Bradford	Holland R.	Industrial - treated	- seasonal
2		Holland R.	Sanitary - treated	- continuous 1.8 mgd
3		Holland R.	Storm - untreated	- continuous
4	Aurora	East Branch, Holland R.	Sanitary - treated	- continuous 2.00 mgd
5		East Branch, Holland R.	Storm - untreated	- continuous
6	Newmarket	East Branch, Holland R.	Sanitary - treated	- continuous 2.00 mgd
7		East Branch, Holland R.	Storm - untreated	- continuous
8	Sutton	Black R.	Sanitary - treated	- continuous 0.18 mgd
9		Black R.	Storm - untreated	- continuous
10	Mount Albert	Vivian Cr.	Proposed sanitary - treated	- seasonal
11		Vivian Cr.	Storm - untreated	- continuous
12	Schomberg	Holland R.	Storm - untreated	- continuous
13	East Gwillimbury Township	East Branch, Holland R.	Industrial - treated	- continuous
14	King Township	Holland R., Drainage Canal South	Industrial - treated	- seasonal
15	Holland Landing	East Branch, Holland R.	Sanitary - treated	- seasonal
16		East Branch, Holland R.	Storm - untreated	- continuous

SIGNIFICANT WATER USES

Scale 1: 200 000

Miles

Kilometres

LEGEND

Municipal and industrial water supplies

- Municipal surface-water source
- Municipal well
- Industrial well

Number beside municipal source refers to the the description in the table 'Municipal Water Supply Systems, 1977'

Irrigation water supplies

- Direct surface-water source
- Well

Use designations: G – Golf course irrigation, M – Market garden irrigation, T – Turf or sod irrigation

Holland Marsh: Area of intensive irrigation of market garden crops; more than 10 million gallons of water per day is authorized for use by over 80 irrigators

Recreational water supplies

- Recreational pond formed by a dam

NOTES

The inventory of surface- and ground-water uses is based on information obtained from the Ministry of the Environment's Abatement and Permit to Take Water programs in the Central Region. Municipal and industrial abatement programs provide detailed information on specific water uses, while the Permit to Take Water program provides more general data on a broad range of users. Under the Permit program most water withdrawals or impoundments of more than 50,000 litres (10,000 gallons) per day are required to be authorized by the Ministry of the Environment.

The estimated total water use in the basin, excluding irrigation, is 8 million gallons per day, of which 85% is from ground-water sources (MOE, 1961-1977).

Irrigation during the summer months is extensive. Over 10 million gallons per day was authorized for withdrawal mainly from surface water sources during the 1977 irrigation season. However, the actual amount used is not known. The permitted amount is distributed amongst the following user groups:

Market Gardening — 93% of total authorized amount
Turf Sod Irrigation — 3% of total authorized amount
Golf Course Irrigation — 4% of total authorized amount

The most concentrated area of irrigation in Ontario is located in the Holland Marsh where market gardeners withdrew throughout the summer growing season (late May to September) from the Holland River and the north and south drainage canals.

Over to 50% of the basin population of 80,000 persons is served by municipal water supply systems, which delivered an average of 4.6 million gallons of water daily in 1977. Over 90 percent of daily municipal water pumpage in 1977 was withdrawn from ground-water sources. The remaining 40% of the population is serviced by private systems at an estimated total withdrawal rate of 1.2 million gallons per day. Approximately 2.2 million gallons per day is withdrawn for industrial and commercial purposes.

Recreational water use is most prevalent in the Oak Ridges Moraine area of the basin where impoundments of headwater streams for aesthetic, recreation and fire protection purposes are popular additions to rural "estates".

MUNICIPAL WATER SUPPLY SYSTEMS, 1977

System	Map Reference	Source	MOE Well Number	System Capacity (mgd)	Average Daily Pumpage: Total (mgd)	Average Daily Pumpage: Per Capita (gal)	Maximum Daily Pumpage (mgd)	Serviced Population (1977)
Newmarket	1	Yonge St. #1 well	4203	3.85	1.87	78	2.48	24,000
	2	Yonge St. #2 well	4204					
	3	Sutton Road #9 well	9134					
	4	Mulock Side Road #13 well	14314					
	5	Davis Dr. #7 well	4193					
	6	Ladyfield #8 well	10143					
	7	Scrigley St. #10 well	4175					
	8	Cotter St. #11 well	4186					
	9	Water St. #12 well	4188					
Aurora	10	Well #1	8523	3.14	1.78	127	2.85	13,900
	11	Well #2	8524					
	12	Well #3	8525					
Holland Landing	13	Well	13655	.504	0.07	58	0.28	1,290
	14	Well	14315		NA	NA	NA	NA
Sharon	15	Well	229		0.01	40	0.03	250
Mount Albert	16	Well #1	14352	.504	NA	NA	NA	NA
Sutton	17	Lake Simcoe		1.00	0.28	64	0.48	4,036
Bradford	18	Well #1	282	1.18	0.52	85	1.04	6,250
	19	Well #2	306					
	20	Well #3	5131					
	21	Well #4	5132					
	22	Church St. #3 well	8791					
Clark Rural Water Supply System (Keswick)	23	Well #1	10904	0.23	NA	NA	NA	NA
	24	Well #2	4256					
Keswick	25	Well #1	4816	NA	NA	NA	NA	NA
	26	Well #2	4817					
Schomberg	27	Well #2	6068	0.22	0.06	73	0.12	825
	28–30*							
Totals		27 wells			4.29	84	6.98	40,475
		Lake Simcoe			0.28	64	0.48	4,036
		All sources			4.55		7.46	44,511

NA - Data not available

*1980 Update: As of September 1980, the following wells were in production at Newmarket: 4203, 4204, 4193, 9134, 4188, 14314 as well as two new wells #14 Sutton Road (Map Ref. 28) and #15 Yonge Street North (Map Ref. 29), rated at 400 and 500 gpm respectively. All other wells are out of service. Also, a fourth production well has been added at Aurora as Aurora #4 well (MOE well log 19114). This well is located between Aurora wells 2 and 3 (Map Ref. 30) and is rated at 1200 gpm.

WATER MANAGEMENT ISSUES

The availability of ground water for future development, the poor quality of surface and ground waters locally, and the effects of the elimination of STP discharges into the East Branch, Holland River at Aurora and Newmarket are major water management issues in the Holland and Black river basins.

Ground water in the Holland and Black river basins adequately supports water supplies for both private domestic and large municipal and industrial water systems. To date, except for localized water-level interference situations, there have been no apparent problems in supplying all large-capacity water demands from ground-water sources. Most municipalities in the basin rely on ground water for community systems and future planning indicates continued interest in further development of ground water.

Most aquifer complexes in the basin are capable of moderate to high water yields, and one area of the basin is heavily committed to high-capacity wells, most of which draw water from deep aquifers. This area is in the vicinity of the towns of Aurora and Newmarket. These two communities make up the high growth area in the basin, where the future development of ground water for municipal supplies is considered desirable. In connection with these municipalities, the Regional Municipality of York plans to develop new wells in the currently producing well fields before 1985, and after 1985 new supplies may be required from more remote areas where further ground-water exploration will be necessary. In order to determine the trends and effects of current pumping on water levels in the producing aquifers, an observation well network in the area is desirable. Data from this network will provide the necessary insight into actual impacts of current withdrawals from the existing aquifers and the necessity for future exploration before the existing supplies are depleted.

Other small communities in the basin will continue to rely on ground water. Its protection and proper utilization cannot be overestimated in the context of water management in this basin. This report provides a general overview of the availability of ground water, and in-depth hydrogeologic investigations should be undertaken to determine the adequacy of ground water for communal water supplies at specific locations.

The Oak Ridges Moraine has sometimes been referred to in its entirety as a "recharge" area. However, as much of the moraine is covered by relatively thick, poorly permeable tills, infiltration of precipitation in the till areas is usually slight and consequently these areas do not provide significant recharge to ground water. This topic is addressed in greater detail in the Duffins Creek-Rouge River ground-water report (Sibul et al., 1977).

Ground water in the basin is variable in quality, generally very hard, and highly mineralized. Total dissolved solids, iron and bacterial contents often exceed MOE drinking water objectives, as do nitrate levels in some areas.

Surface water in the basin shows large fluctuations in quality from year to year. Annual trends are not readily apparent. Generally, the Holland River and the East Branch of the Holland River show relatively poorer quality than the Black River. Specific parameters that exceed MOE Provincial Objectives at some locations are total and fecal coliform, fecal streptococci, iron, total dissolved solids and colour. A significant water management goal for the Holland and Black rivers is maintaining and enhancing water quality in order to ensure the availability of surface water for a wide range of possible future uses.

Methods of improving surface-water quality should include discouraging the construction of on-stream ponds, especially in headwater areas, and improving controls on agricultural runoff. On-stream, usually dam-formed ponds have a direct effect on water temperatures and increased aquatic growth. Such effects contribute to impaired water quality at the site as well as downstream. In addition, during low-flow periods, improper operation of dams can further reduce outflow, thus limiting surface-water usage in the downstream areas. These problems can often be reduced or eliminated by the construction of off-stream or connected ponds. Agricultural runoff, which seems to contribute to high bacterial and nutrient levels at many locations in the study area, should be contained as much as possible in line with Ministry of Agriculture guidelines.

High bacterial levels in the surface water, notably downstream of Aurora and Newmarket, can be attributed to sewage treatment plants (STP) and private sewage system discharges. STP inputs from Aurora and Newmarket will be eliminated by 1985 as the two sewage treatment plants will be connected to the Central York Sewage Servicing System.

The elimination of the Aurora and Newmarket STP discharges will improve surface-water quality in the downstream reach of the East Branch, Holland River. At the same time, it is estimated that elimination of the STP discharges will result in about a 15% reduction in the mean annual discharge in the East Branch, Holland River at the Holland Landing streamflow gauge. Also, monthly flows may be reduced by up to 44% during summer months. While the exact effects of this reduction are not known, it is anticipated that if any problems arise they will likely relate mainly to in-place aesthetic and recreational interests.

METRIC CONVERSION FACTORS

1 inch	=	2.540 centimetres
1 foot	=	0.3048 metres
1 gallon	=	4.546 litres
1 cubic foot per second	=	28.32 litres per second

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Cartography by D. Griffin

Base map derived from 1:50,000 sheets of the National Topographic series.

Ontario
MINISTRY OF THE ENVIRONMENT
Water Resources Branch
Hydrology and Monitoring Section

WATER RESOURCES REPORT 15

WATER RESOURCES OF THE HOLLAND AND BLACK RIVER BASINS

Sheet 7

WATER RESOURCES MANAGEMENT

MAP 2263


Thames River Basin
Big Otter Creek Basin
Big Creek Basin
Upper Nottawasaga River Basin
HOLLAND AND BLACK RIVER BASINS
Dufferin Creek
Rouge River Basin
Moira River Basin
South Nation River Basin
SOUTHERN ONTARIO
INDEX OF DRAINAGE BASIN STUDIES
Area of previously published drainage basin studies
Kilometres
0 20 40 60 80 100 120 140
LAKE HURON
LAKE ONTARIO
LAKE ERIE
QUEBEC
MICHIGAN
NEW YORK
PENNSYLVANIA
OHIO
TORONTO
HAMILTON
BUFFALO
DETROIT
WINDSOR
LONDON
OTTAWA